Evaluating Options to Increase Specific Service (Logo) Signs From Six Businesses to Nine Businesses per Service

FINAL REPORT

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Executive Summary

In an effort to meet the rising demand for logo positions on specific service signs at North Carolina interchanges, NCDOT developed a 9-panel design and an overflow combination as two experimental alternatives to the current 6-panel logo sign. To evaluate the effect of the new signs on interstate motorists, motorists were observed at five 9-panel locations, five overflow locations, and six standard 6-panel locations. An observer recorded instances of unusual behaviors, including braking, drifting, and lane line encroachment. The rates of these unusual behaviors at both experimental sign locations were not found to be significantly different from rates at standard 6-panel sign locations. The findings of this research indicate that the experimental 9-panel and overflow logo signs do not increase motorist distraction and therefore do not have a negative effect on safety.

Introduction

There are specific types of service panels permitted along interstate highways to provide information to passing motorists of available services near by.
These specific services include gas, food, lodging, camping, and attractions.

Problem Statement

North Carolina business communities have an increasing desire to advertise their businesses on highway service panels. The current rule in the MUTCD is that Specific Service (Logo) signs shall be limited to six logo panels (MUTCD 2F.02 and 2F.04) (*1)*. Current MUTCD language also confines a single service type to one sign. However, in September 2006, the Federal Highway Administration issued interim approval for the use of up to 12 logo panels for any one specific service type over a maximum of two signs. The MUTCD also sets a four sign maximum limit to the number of service signs along an interchange or intersection. This limit will be maintained under the interim approval.

In an effort to meet the rising demand for logo positions on service panels and to provide additional service choices to the motorist, NCDOT developed two possible alternatives. These alternatives are:

1) 9-Panel Sign – a single board displays 9 logo business panels (see Figure 1b)
2) Overflow Combination – a single service type has panels on more than one logo sign at a given interchange, thus the overflow sign has two services (e.g., food and gas) shown on the same sign in addition to a full 6-panel sign for that service (see Figure 1c)

a) 6-Panel Sign (current standard)

b) 9-Panel Sign

c) Overflow Combination. Six-panel sign (left) followed by overflow sign (right)

These new design strategies (Figures 1b and 1c) are intended to provide traveling motorists with more information on specific services available at upcoming interchanges. However, before implementing (or recommending to implement) on a large scale, NCDOT desires to ensure there is not a negative effect on safety. If it were determined that more logos add to driver distraction, motorists may pay less attention to the road. In order to test the effects on the motorists' driving behaviors and determine if these strategies have a negative effect on safety, NCDOT sponsored the UNC Highway Safety Research Center to conduct a research study on selected sites throughout North Carolina where the experimental 9-panel and overflow signs had been installed or were soon to be installed.

Objective

The objective of this study was to evaluate whether implementation of 9-panel and overflow combination signs have a negative effect on highway safety.

Past Research

There have been similar studies in the past relating to effects of panel board modifications. The Texas Transportation Institute conducted a survey to measure the effect of dual logo panels (*2*). Dual logo panels were suggested to resolve the issue of business owners desiring to advertise two different brands under the same roof (e.g., KFC and Taco Bell). The study focused on service type categorical placement, dual logo recognition and legibility, and information overload to highway motorists. A 40-question survey had three components to each question: a question slide asking if a specific business is advertised, a picture slide containing dual logo panels, and an answer slide where the respondent choose either “yes,” “no,” or “not sure.” Questions were given at different time intervals. Two hundred participants took this driver survey. The findings showed that dual logo panels had good recognition levels with exposure time and driver familiarity and that dual logo panels should not be prohibited.

The Virginia Tech Transportation Institute performed a similar study for VDOT (*3*). The objectives were to determine whether combining Full Service Food panel with another service type panel on motherboards would be acceptable and understandable by passing motorists and to determine whether crashes would increase as a result of the new motherboard setup. Seven sites of the experimental sign installation were examined. The team’s method was to use a random-digit dialing telephone survey in combination with an accident database on both study and control sites. The survey prescreened respondents for familiarity with Virginia highway travel and logo signs and from that interviewed 804 participants. The accident database contained all accidents from 1999 through 2003 that occurred on Interstate 64, Interstate 81 and Interstate 95. The results indicated no additional safety risk and low confusion regarding the new changes.

Although these studies show that proposed unconventional logo sign designs have worked well in other states, this study examines the impact of unconventional sign design strategies on North Carolina motorists.

Methodology

This study evaluated the safety effect of logo signs on passing motorists by measuring observable driving behaviors. Should these unconventional panels be unreasonable distractions, one would expect observable erratic driving behavior within the vicinity of the logo panels.

Data collection entailed recording traffic for one hour at each site. Once the driving behavior video footage was collected, the tapes were reviewed and unusual behaviors of motorists were recorded. The targeted unusual behaviors consisted of the following:

- Braking – the driver slowed by braking; indicated by brake lights.
- Drifting – the driver drifted in the lane but did not touch either lane line.

- Encroaching on lane line – the driver encroached on the dashed line dividing the travel lanes.
- Encroaching on edge line – the driver encroached on the solid line separating the travel lane from the paved shoulder.

Site Selection

Fifteen logo signs at twelve interchanges across North Carolina were selected for this study (see Appendix A for site list). Ideal study sites were those located on a stretch of straight road (to provide a good vantage point for videotaping) and where the videotaping could be accomplished non-intrusively and safely. Per NCDOT's request, the research team also made an effort to include any sites where filming could be done before and after sign installation. Only one site of this type was found to be suitable for inclusion in the study (I-95 at Exit 121). In all, data were collected at five 9-panel signs, five overflow signs, and five 6-panel signs (plus an additional 6-panel as the "before" period of one of the 9-panel sites).

Interchanges that had the overflow combination design were studied at both signs. The first sign, the standard 6-panel, was used as a control site, while the downstream overflow sign served as a study site for the overflow design. In addition to increasing the efficiency of data collection, this method provided a better matched pair in terms of traffic volume and profile than would have been found at a randomly selected 6-panel location. Of the six 6-panel signs at which data were collected in this study, four were part of an overflow combination design.

Data Collection

Data collection for two pilot test sites occurred in February 2006. Data collection for the rest of the sites commenced in June 2006 and was completed in October 2006.

Prior to conducting data collection at the pilot sites, the team conducted a test run on I-40 in Durham. By taking video footage from a variety of angles, it was determined that the best possible view for data collection would be a viewing angle that was as close as possible to the travel lanes (i.e., not far off on the shoulder). This would allow the observer to accurately determine if lane drifting and shoulder encroachments occurred.

One important parameter to define was the target viewing area in the video. The target area needed to encompass enough roadway length to capture useful data on driver behaviors but not so much that it would be difficult to see the behaviors as they occurred. It was decided that 800 feet was the amount of roadway length that could feasibly be viewed in the video frame. Thus, the data collection was situated to capture a viewing area from the sign of interest to approximately 800 feet upstream of the sign.

The video camera needed to be placed in such a way that it would not be conspicuous and affect behaviors of the drivers as they passed through the target area. It was determined that the best placement of the camera would be upstream of the target area, zoomed in to the appropriate viewing of the target area (Figure 2). The possibility of placing the camera at the sign and viewing the vehicles as they approached the sign was considered but was discarded since the brake lights of the vehicles would not be visible from that position. Overhead positions (e.g., nearby overpasses) within 800 feet of the logo sign were not available at the study sites.

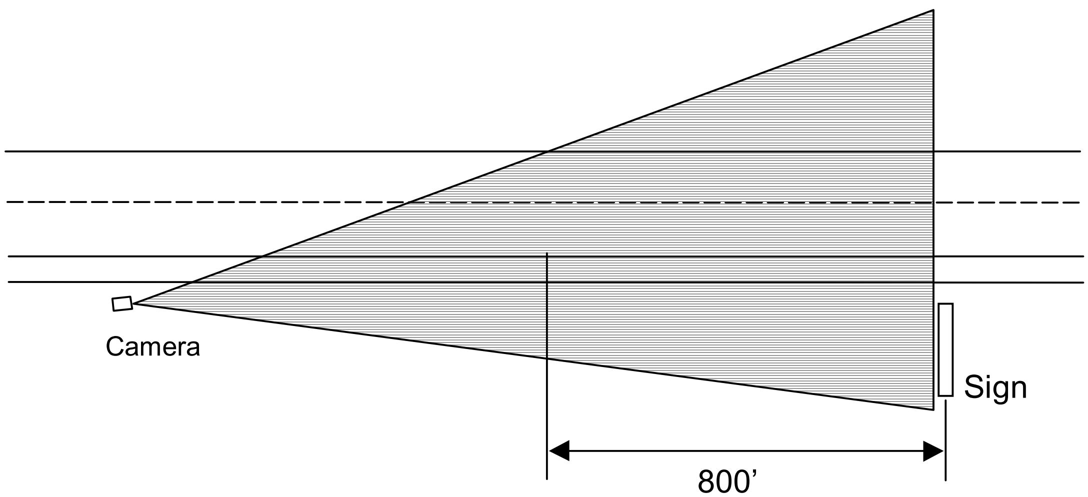

Figure 2. Illustration of Target Viewing Area

The camera was situated on a tripod placed on the ground in front of the data collector’s car (Figure 3). The height of the tripod did not significantly affect the quality of viewing and could be adjusted for the best view at each site. For example, the camera in Figure 3 was lowered to be able to include the sign of interest in the shot (needed to see under another sign that was closer). Additionally, placing the camera in front of the car allowed it to be hidden from motorists, so as to minimize bias from motorists who felt they were being watched.

Figure 3. Video Camera Placed in Front of Parked Vehicle

A Sony Digital Handycam DCR-VX2000 camcorder using 60-minute MiniDV tapes was used to record driver behaviors. One hour of video was recorded for each site. Traffic volume was counted by individual lanes during this hour. For sites with more than two lanes in the direction of interest, only the two rightmost lanes were included in volume counts and subsequent data reduction. Drivers who were concerned with exiting for food would presumably be in one of these two lanes.

It was assumed that the new sign design would have the greatest effect on drivers who were unfamiliar with the area and who were looking for a place to stop. Presumably the most traffic from out-of-town drivers would be on or near the weekend. Thus, data collection was conducted on Fridays and Saturdays for any hour between 11:30am and 2:00pm.

Data Reduction

The tapes were viewed in an office by an observer who recorded instances of the four specified unusual driver behaviors (braking, lane drifting, encroaching on the lane line, and encroaching on the shoulder line). For each unusual behavior event, the time, lane, and specific behavior were recorded, as well as the reason for the behavior, if apparent. At the end, the frequency and rate of occurrence of each behavior were calculated per lane for each site. Frequency was defined as the number of unusual behavior occurrences per hour while the rate was defined as the number of unusual behavior occurrences per 1000 vehicles. To account for variations in traffic volume among the sites, rate was the measurement used for the data analysis.

Results

Table 1 shows the comparison of the rates of unusual driver behaviors between both types of experimental designs (9-panel and overflow) and the control group (6-panel). The rate of unusual behaviors for each design strategy was calculated as an overall average of the average rate at each site (thus every site's average rate had equal weight in the overall average). This avoided creating a bias from higher volume sites.

Overall Comparison

The 9-panel sites had lower observable average rates of unusual behaviors than the 6-panels in both lanes (Table 1). The overflow sites had a lower observable average rate in lane 1 (rightmost lane) and a slightly higher average rate in lane 2 (second to rightmost lane).

Table 1. Comparison of 9-Panel and Overflow Sites to 6-Panel Sites

Site Type	Lane*	Rate of Unusual Behaviors**	Comparable 6-Panel Rate**	Difference	T-test p-value	Significant Difference? †
9-Panel	Lane 1	31.2	38.4	-7.2	0.55	no
	Lane 2	9.8	13.1	-3.4	0.47	no
	Both lanes	41.0	51.6	-10.6	0.49	no
Overflow	Lane 1	29.5	38.4	-8.9	0.48	no
	Lane 2	13.8	13.1	0.7	0.32	no
	Both lanes	43.3	51.6	-8.3	0.62	no

* Lane 1 is the rightmost lane. Lane 2 is the next lane over.
** Total unusual behaviors per 1000 vehicles
† Confidence level of 90%

To examine statistical significance of these differences, the researchers used a t-test to compare the difference in mean rates. The resulting p-values are shown in Table 1. As can be seen by the high p-values, there were no significant differences in the rates between either of the experimental sign designs and the standard 6-panel design.

Comparison of Behavior Types

Table 2 shows the breakdown of behaviors by behavior type. The most frequent motorist behavior by far was braking in all three groups. The data collector noted many factors that could contribute to the predominance of the braking behavior - downhill grade of the road, vehicles entering a heavy traffic pack, and vehicles following other vehicles during lane changes – in addition to possible braking due to other highway distractions, such as signs.

Table 2. Comparison of Behavior Types

Behavior Type	Average Rate of Unusual Behaviors per 1000 Vehicles					
	9-Panel		Overflow		6-Panel	
	Lane 1*	Lane 2	Lane 1	Lane 2	Lane 1	Lane 2
Braking	22.3	9.8	18.5	11.3	21.1	11.9
Drifting	0.0	0.0	0.0	0.0	0.1	0.0
Dashed Lane Line Encroaching	0.2	0.0	1.9	2.5	10.4	1.3
Shoulder Edge Line Encroaching	8.8	0.0	9.1	0.0	6.8	0.1

* Lane 1 is the rightmost lane. Lane 2 is the next lane over.

Encroaching on the shoulder edge line was another observed behavior. The majority of shoulder encroachments came from heavy trucks. Encroaching on the dashed lane line was rare. However, in one particular 6-panel location, light traffic volumes may have caused drivers to be more liberal in their driving space. There were incidences where vehicles attempted to change lanes but could not due to approaching traffic. There are also incidences where the road was curved and vehicles appeared to encroach on the lane line. Drifting was virtually non existent.

Before-After Site Evaluation

The researchers were able to obtain video footage of one site before and after sign installation. The 6-panel logo sign at the location (I-95 exit 121 in Wilson) was replaced with a 9-panel sign. Although the sign replacement was done on both the northbound and southbound approaches, only the southbound approach was suitable for data collection. The northbound approach had a vertical crest which did not provide a good vantage point for videotaping. As is shown in Table 3, the rate of unusual behaviors did not increase after the experimental sign was installed.

Table 3. Comparison of Before and After Conditions

Site	Type	Date	Hourly Volume Observed	Rate of Unusual Behaviors per 1000 Vehicles		
				Lane 1	Lane 2	Both Lanes
1.13 SB (before)	6-Panel	6/16/2006	1404	37.2	20.1	57.2
1.13 SB (after)	9-Panel	10/20/2006	1326	28.7	5.1	33.7

Conclusion

The rates of unusual behaviors at the experimental 9-panel and overflow sites were not significantly different than rates at standard 6-panel sites. In fact, the rates were generally lower at the experimental sites, but not at a statistically significant level. At the before-after site, the rates of unusual driver behaviors were lower after the 9-panel sign was installed. The findings of this research indicate that the experimental 9-panel and overflow logo sign designs do not increase motorist distraction and as a result they do not have a negative effect on safety.

References

1. Manual on Uniform Traffic Control Devices, Federal Highway Administration, 2003 Edition, Revision 1, November 2004.

2. Hawkins, H. Gene and Elisabeth Rose, “A Human Factors Study of the Effects of Adding Dual Logo Panels to Specific Service Signs”, Transportation Research Board 84th Annual Meeting, Paper No. 05-2605, Washington, DC, January 2005.

3. Lee, Suzanne and Jeremy D. Sudweeks. “Evaluation of Safety and Acceptance of Logo Motherboards Containing More Than One Service Type”, Transportation Research Board 85th Annual Meeting, Washington, DC, January 2006.

Appendix A. Study Site List

Site ID	Sign Type	County	On Road	Interchange Routes	Exit Number	Direction	Speed Limit	Total Number of Lanes	Mainline 2003 AADT (both directions)
1.2	9-Panel	Robeson	I95	US301 (Fayetteville Rd)	22	SB	65	4	44,500
1.5	9-Panel	Iredell	I40	US21	151	EB	60	4	32,500
1.6	9-Panel	Iredell	I77	NC150	36	SB	65	4	53,500
1.9	9-Panel	Henderson	I26	US64	49 (Old 18)	WB	65	4	52,500
1.13 (after)	9-Panel	Wilson	I95	US 264	121	SB	70	4	29,500
2.1	Overflow	Martin	US64	NC125 (Prison Camp Rd)	512	EB	70	4	9,400
2.10	Overflow	Alamance	I85 / I40	NC119	153	WB	65	8	78,000
2.18	Overflow	Buncombe	I26	NC 191	33	WB	65	4	68,000
2.3	Overflow	Cabarrus	I85	SR 2126 (Earnhardt Rd)	60	SB	65	4	66,500
2.7	Overflow	Mecklenburg	I77	NC73 (Sam Furr Rd)	25	NB	65	4	75,000
1.13 (before)	6-Panel	Wilson	I95	US 264	121	SB	70	4	29,500
2.17	6-Panel	Buncombe	I26	NC 146 (Long Shoals Rd)	37	WB	65	4	43,700
2.3	6-Panel	Cabarrus	I85	SR 2126 (Earnhardt Rd)	60	SB	65	4	66,500
2.7	6-Panel	Mecklenburg	I77	NC73 (Sam Furr Rd)	25	NB	65	4	75,000
2.18	6-Panel	Buncombe	I26	NC 191	33	EB	65	4	68,000
3.11	6-Panel	Martin	US64	US 17	514	EB	70	4	10,000

Note: 6-panel sites with a designation of 2.x were part of an overflow combination, as described on page 6.